CANADA

DEPARTMENT OF AGRICULTURE

RESEARCH BRANCH—FOREST BIOLOGY DIVISION

Vol. 15
REPORT
Number 4

BI-MONTHLY PROGRESS REPORT

July-Aug.
1959

Published by Authority of the Hon. Douglas S. Harkness, Minister of Agriculture, Ottawa

CURRENT ACTIVITIES

QUEBEC

A Modification of the Wood Block Decay Test for Studying Imperfect Fungi.—In the course of ecological studies of fungi associated with the dead branches of aspen, information was needed on the minimum moisture requirements of several non-decaying-producing fungi whose rate of development in wood could not be measured by standard loss-in-weight methods. To overcome this difficulty a modification of the method for studying the decay of wood in culture (Etheridge, D. E. Can. J. Bot., 35: 615-618. 1957) was tested and found satisfactory.

Except for the method of inoculating the blocks and of recording the rate of development of the fungi, the procedure for maintaining uniform moisture conditions and other details of the technique can be obtained from the reference cited above. Tests are carried out with $\frac{3}{4}$-inch blocks of wood. A hole to take the water amendment and inoculum is bored in the centre of one of the tangential faces of each block to a depth of $\frac{1}{2}$ inch using a drill $\frac{1}{4}$ inch in diameter. After adding the required amount of water, the blocks are inoculated with small plugs of agar taken from actively growing plate cultures of the test fungus. The inoculum is transferred to the bottom of the bore-hole and sealed in this position with a sterile $\frac{3}{4}$-inch section of glass rod of $\frac{9}{32}$-inch diameter. To reduce chances of contamination, the face of the block with the protruding end of rod is then passed quickly through a flame.

The rate of development of the test fungus is measured by noting the number of days required for hyphae to grow through the $\frac{1}{2}$ inch of wood separating the inoculum from the surfaces of the block. After 2 or 3 weeks, growth appears on the surface, usually as a small cushion or tuft of mycelium immediately above the site of the inoculum and can be detected without difficulty by holding the culture jar in such a way that the surface of the block being examined is against the light. Detection of the fungus is greatly simplified when a more conspicuous concomitant of growth, such as discoloration of the wood by stain fungi or the production of fruiting-bodies is the object of study. For example, in recent trials with several imperfect fungi, cultures of *Cytospora chrysosperma* and *Phoma* sp., under appropriate cultural conditions, produced pycnidia which were at first (3 weeks after inoculation) confined to an area on the transverse surfaces of the blocks that corresponded exactly to the configuration of the underlying cavity containing the inoculum. Since the number and size of pycnidia within this confined space varied with the amount of moisture in the wood, critical conditions for sporulation of these fungi could be estimated quite rapidly by macroscopic inspection only.

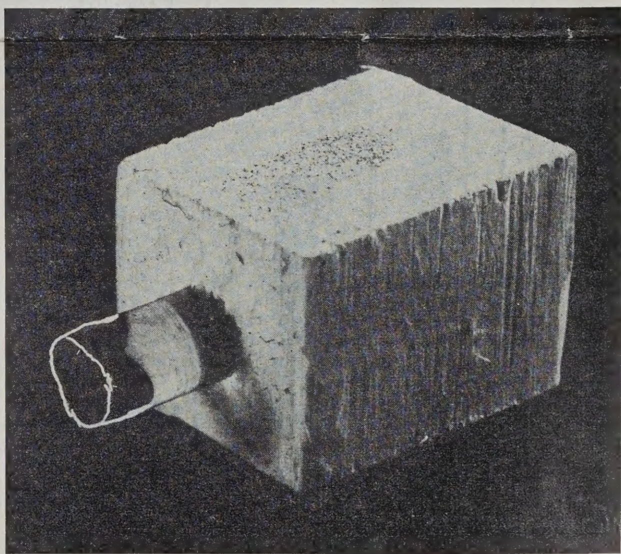
The method has also proved advantageous in studying the minimum moisture requirements of fungi. Table 1 records the presence or absence of growth on the transverse surfaces of blocks of aspen wood after these had been incubated with various test organisms for 3 weeks at four different constant humidities. In every case negative results obtained by visual inspection were confirmed by failure to reisolate the test fungus from the wood. From these data it may be concluded that the method is satisfactory for detecting extremely critical differences in the moisture requirements of wood-inhabiting fungi. It has an advantage over methods based on the loss in weight of wood substance because positive results can be obtained in a much shorter time, thus reducing changes in moisture content to a minimum.—D. E. Etheridge and L. A. Morin.

TABLE 1

MINIMUM WOOD MOISTURE CONTENTS FOR GROWTH OF DIFFERENT FUNGI

Cytospora chrysosperma		*Phoma* sp.		*Libertella* sp.	
M*	Results	M	Results	M	Results
14.5	No growth	14.3	No growth	14.2	No growth
14.5	"	14.7	"	14.3	"
14.6	"	15.1	"	14.8	"
23.3	"	23.7	"	22.3	"
23.4	"	23.9	"	23.2	"
23.8	"	24.1	"	23.8	"
23.9**	Growth	24.3	"	24.0	"
24.8	"	24.6**	Growth	24.2	"
25.2	"	24.6	"	24.5	"
25.6	"	24.9	No growth	25.8**	Growth
25.7	"	24.9	Growth	26.0	"
25.7	"	24.9	"	26.0	No growth

* Mean moisture content.
** Minimum moisture content for growth.



Pycnidia of *Phoma* sp. occurring on the transverse surface of a test block which has been prepared according to this method.

Ascospore Discharge in Mycosphaerella populorum Thompson.—In many fungous parasites of leaves primary infection originates from the maturation and dissemination of ascospores produced in overwintered leaves. Prevention or inhibition of this process offers a sound control measure where such spores are the key-factor leading to severe outbreaks of the disease. In order to study the effect of environmental factors it is desirable to induce spore maturation and discharge under more rigidly controlled conditions than can be attained in the field.

To study the role of temperature on this process and to ascertain the feasibility of artificially inducing maturation of perithecia, leaves were collected from *Populus deltoides* Marsh. just prior to leaf fall (October 20, 1958) on a plot severely infected by *Mycosphaerella populorum* at Berthierville, Quebec. The leaves were air dried and discs were cut from them with a No. 9 cork borer. These were then subjected randomly to each of the following

treatments: (1) 15 days at 5°C. (in incubator), then 45 days at —10°C. (2) 60 days outside (leaves were placed in a small cage and laid on the ground where they became covered with snow; maximum air temperature during exposure was 13°C., minimum —28°C.). (3) 60 days at 5°C. (in incubator). (4) 60 days at room temperature (approximately 22°C.).

At the end of this period the discs were removed, soaked in water for 12 hours and 5 discs were placed in each petri dish containing a layer of washed, sterilized sand at its water holding capacity. Microscope slides were affixed to the upper half of the petri dish to collect the spores. Ten discs from each treatment were then subjected to each the following temperatures: (a) 22°-26°C. (b) 13°-18°C. (c) 7°-13°C.

The slides were examined cursorily every two days until ascospore discharge became abundant. Estimations of total spore discharge were made each day by counting the spores in four transverse sections of the slides under the low power objective of the microscope. This was continued until spore discharge evidenced a continual downward trend.

Spore counts on the day of peak discharge and for three days afterwards were averaged to obtain the values presented in Fig. 1. No discharge occurred at 7°-13°C. but on transfer to 22°-26°C. active discharge was obtained.

This experiment showed that perithecia of *M. populorum* can be brought to maturation under controlled laboratory conditions. A resting period at a temperature below the freezing point and of not more than 45 days seems necessary to induce maturity of perithecia. Upon maturation a period at relatively high temperatures (22°-26°C.) stimulated active spore discharge while lower temperatures (7°-13°C.) proved inhibitory. It is thought that moderate spring temperatures (20°-26°C.) are probably sufficient to stimulate epiphytotic outbreaks on *P. deltoides* early enough in the growing season to reduce increment seriously.—M. G. Boyer.

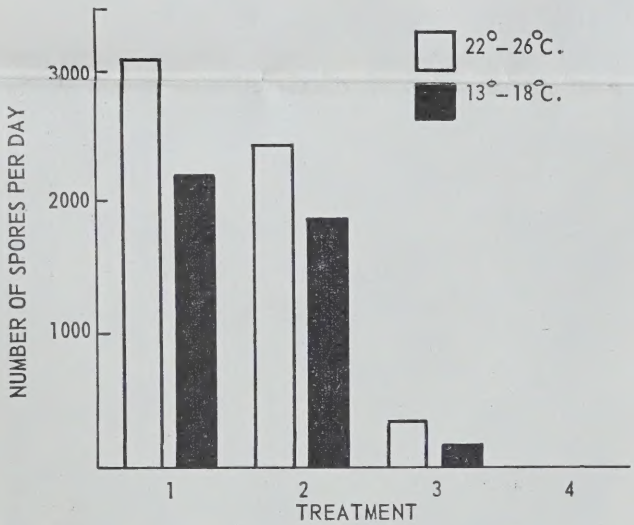


Figure 1.—The effect of different treatments on ascospore discharge in *M. populorum*.

ONTARIO

Effectiveness of Fungicidal Applications on Damping-off of Red Pine.—In 1956 an experiment was carried out at the Orono Nursery to determine the effectiveness of 7 levels of application of 3 fungicides in the control of damping-off in red pine seed beds. The fungicides tersan, captan, and thioneb were applied as drenches at the rate of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, and 3.5 g./sq. ft. Applications of the fungicides were made at weekly intervals. The fungicidal treatments were applied at random in four replications and the levels of application were distributed at random within each treatment.

Mortality and emergence data were recorded from sample areas within the treatments for the period June 11 to July 6. A statistical analysis of these data showed that there was a significant reduction in mortality between the levels of application, the reduction increasing as the concentration of the fungicides increased and that seedling emergence increased significantly with the higher levels of application. A comparison of the effects of the fungicides showed that there was no significant difference between the three chemicals, either in the reduction of mortality or the emergence of the seedlings.

The results obtained from this study agree in general with those found in other investigations (Cram, W. H. and O. Vaartaja. Rate and timing of fungicidal soil treatments. Phytopath. 47: 3. 169-173. 1957) and indicate that a reasonable degree of control of damping-off may be obtained by applying fungicides directly to the seed bed during the early stages of seeding growth, these applications being made as they are warranted by the severity of the attack.—J. Cockerill.

TABLE 1

Analysis of Variance of Mortality Data

Source of variation	S.S.	d.f.	M.S.	f.
Replications	234	3	78	<1
Fungicides	1,674	2	837	3.5
Error	1,440	6	240	
Levels	3,485	6	580	10.8**
Replications x levels	808	18		
Fungi x levels	819	12	68	1.3
Error	2,098	36	53	
Total	10,561	83		

**at 1 per cent level
$n_2 = 54$

TABLE 2

Analysis of Variance of Emergence Data

Source of variation	S.S.	d.f.	M.S.	f.
Replications	1,160	3	386	<1
Fungicides	531	2	265	<1
Error	8,182	6	1,363	
Levels	6,272	6	1,045	2,3*
Replications x levels	7,260	18		
Fungi x levels	4,709	12	392	<1
Error	17,547	36	459	
Total	45,664	83		

*at 5 per cent level
$n_2 = 54$

New Distribution Records and Notes on an Arborvitae Leaf-Miner in Ontario.—Until the work of Silver (1957, Can. Ent. 89:97-107, 171-182) on separating the Arborvitae leaf miners in New Brunswick, the immature stages of *Argyresthia aureoargentella* Brower had been confused with three other leaf miners of cedar in Ontario, namely, *Argyresthia thuiella* (Pack.), *Argyresthia freyella* (Wlshm.). and *Recurvaria thujaella* Kft. Consequently, before 1957 *A. aureoargentella* was considered erroneously by the Forest Insect Survey (Ontario) to be a rare species.

During 1957 and 1958 a broad range of distribution of *A. aureoargentella* across Ontario was established. It is now known to occur on eastern white cedar, *Thuja occidentalis* L., in all forest districts except the following: Sioux Lookout, Kenora, Cochrane, Swastika, Pembroke, Lake Huron and Lake Erie. Cedar foliage in some of these districts was examined but the insect could not be found.

Although cocoons were usually found in small numbers, one infestation of *A. aureoargentella* was detected in 1957 in a 20-acre cedar grove on St. Joseph's Island east of Sault Ste. Marie. Cocoons were abundant on the underside of branches that bore considerable mined foliage. The rearing results for 250 cocoons that were collected from this infestation on June 24, 1957 and reared in the laboratory were as follows: 60 per cent completed adult development; 23 per cent were parasitized; and 17 per cent were dead from unknown causes. Adult emergence extended over the period from July 1 to July 19. By 1958 much of the damaged foliage had dropped, the number of *A. aureoargentella* had been markedly reduced and two other miners, *A. thuiella* and particularly *R. thujaella,* had become numerous.

Three families were represented among the four species of parasites reared from *A. aureoargentella.* These, identified by the Systematics and Biological Control Unit, Ottawa, occurred in order of abundance as follows:

Braconidae	*Apanteles paralechiae* Mues.
Encyrtidae	*Pentacnemus bucculatricis* How.
Eulophidae	*Pnigalio* sp. ? *tischeriae* (Ashm.)
	Pnigalio sp. ? *kukakensis* (Ashm.)

Three of the four are new records from *A. aureoargentella, P. bucculatricis* being the exception. *Pnigalio* sp *?* *kukakensis* was the only species not recorded previously by Silver as a parasite of other Arborvitae leaf miners in eastern Canada.—O. H. Lindquist & W. L. Sippell.

BRITISH COLUMBIA

The Pest Control Committee, B.C. Loggers' Association.—January 4, 1957, marked an important milestone in the development of forest protection in British Columbia. On that day the Board of Directors of the British Columbia Loggers' Association passed a resolution establishing a permanent Pest Control Committee. The principal aims of the committee are (a) to organize and direct control operations against forest insects and diseases in the coastal areas of British Columbia, (b) to assist the Forest Biology Division in carrying out surveys and research on problems of immediate concern to the Association and (c) to serve as a clearing house for information on forest insects and diseases. Although its terms of reference include work on tree diseases, the nature of the problems that have arisen since its inception has led the committee to devote most of its efforts to insect pests. This article describes events leading to the formation of this committee, its membership and mode of operation, and important projects undertaken.

On January 10th, 1956, a meeting attended by company and government foresters was held at the Forest Biology Laboratory, Victoria, to consider a serious situation created by a black-headed budworm outbreak which had developed on the northern part of Vancouver Island. It was agreed that more intensive surveys than could be handled by the staff of the Forest Biology Laboratory were necessary to follow the course of the outbreak, and that assistance from the logging industry and the British Columbia Forest Service would be highly desirable. To facilitate the co-ordination of activities between these agencies a special committee was set up by the participating firms. Mr. W. S. Hepher, Chief Forester, Alaska Pine and Cellulose Co. Ltd., agreed to act as chairman. The B.C. Forest Service and the Forest Biology Laboratory were represented on the committee.

During 1956 this informal group successfully supported several projects to be mentioned later. These activities culminated in a report in November, 1956, by the Forest Biology Laboratory which resulted in a decision by the companies and the B.C. Government to spray about 156,000 acres of hemlock in 1957 for control of the black-headed budworm. This was the last in a series of events which led the member companies to decide to form a permanent Pest Control Committee under the sponsorship of the B.C. Loggers' Association. All the companies participating on the committee were members of the Association. The committee would have the backing of a large and well-established organization, and the arrangement would facilitate the preparation and signing of contracts and other agreements. It was this newly constituted committee which then organized and directed the aerial control operation.

Mr. W. S. Hepher was requested to act as chairman of the new committee, a post which he accepted and has held up to the present. The following companies were initially represented: Alaska Pine & Cellulose Co., Ltd., British Columbia Forest Products Ltd., Canadian Forest Products Ltd., Crown Zellerbach (Canada) Ltd., MacMillan and Bloedel Ltd., Powell River Co., Ltd., and Tahsis Co., Ltd. The committee has power to add representatives of other companies. Representatives of the B.C. Forest Service and the Forest Biology Division act on the committee as advisers. The committee has power to act in all matters, provided that commitments for expenditures of Association funds be first approved by the Directors. Meetings are held as required.

Another significant development took place on January 1, 1959, when the Association appointed Mr. H. A. Richmond as consultant. Mr. Richmond acts as liaison officer between the industry, government, and university research groups, reports to the Association on survey and research findings on insects and diseases, represents the industry on co-operative studies, and acts as project manager on any pest control project in which the Association bears a portion of the direct costs. Mr. Richmond is particularly well qualified for this position because of his many years of experience with forest pest problems and his long association with the Forest Biology Division.

Although the committee has been operating as an organized group for only three and one-half years, its record of accomplishments is impressive. The following is a list of some of the more important activities undertaken:

1. In 1956, it supported with manpower and funds aerial spraying experiments to determine suitable dosages and formulations of DDT, and the best time to apply insecticide for effective control of the black-headed budworm.
2. In the fall of 1956 and 1957, it assisted the Forest Biology Laboratory in the extensive black-headed budworm egg surveys by supplying personnel, transportation and accommodation. These surveys provided the basic information required for decisions on control operations.
3. It successfully organized and directed, in 1957, the largest forest insect aerial spraying program yet carried out in British Columbia. The cost of this project was shared by the Federal and Provincial governments and the companies.
4. Aircraft have been supplied as needed for aerial surveys to map the extent and severity of insect outbreaks.
5. The committee has supported and encouraged studies designed to reduce mortality to fish caused by pest control operations. Close liaison has been maintained with Federal and Provincial fisheries authorities.
6. The committee has promoted the dissemination of information on forest pests among company personnel. Member companies on many occasions have individually assisted directly in surveys of company holdings.
7. A co-operative project is in progress with the Forest Biology Laboratory to determine if helicopters can be used successfully to spray logs in woods settings to reduce damage caused by ambrosia beetles. The committee supplied co-ordinating services by H. A. Richmond, aircraft, insecticide, and a seasonal assistant. Member companies provided the necessary settings.
8. The committee has also initiated experimental aerial spraying of log booms in water to prevent attack by ambrosia beetles.

The need for the Pest Control Committee arose out of a specific problem. However, it was quickly realized by all participating agencies that a committee of this type performs a very useful continuing function. It provides a means of joining forces and taking unified action whenever it is needed, and an organization to direct and carry out control operations. The situation in British Columbia furnishes a unique and unequalled opportunity for action of this type. The head offices of most of the major logging companies operating on the west coast are concentrated in Vancouver. This permits meetings to be called on short notice, as frequently as needed, and allows decisions to be reached quickly. These are important considerations in meeting problems promptly and effectively.—R. R. Lejeune.

Moisture Relations in Disease Development with Particular Reference to Canker Diseases Caused by Native, Facultative Parasites.—In recent studies a close correlation was found to exist between the development of Cryptodiaporthe canker on willow (*Cryptodiaporthe salicina* (Curr.) Weh.), Fusarium canker on *Populus trichocarpa* Torrey and Gray (*Fusarium lateritium* Nees.), Cephalosporium canker on western hemlock (*Cephalosporium* spp.), and the moisture content of the living host bark. When bark moisture was expressed as a percentage of the amount of water required to saturate the sample under experimental conditions, relative turgidities of 80 per cent or more inhibited canker development which, however, occurred normally at lower percentages. It is possible, therefore, that relative turgidity measurements provide indices for the determination of the resistance or susceptibility of the host trees to this type of disease. Further, the experiments indicated the importance of maintaining a satisfactory level of relative turgidity in the bark of trees and cutting stock as a cultural method designed to prevent these diseases.

It has been demonstrated that seasonal changes occur in the relative turgidity of the bark of the host trees which are closely correlated with the epidemiology of the canker diseases in the Vancouver district. Thus during the dormant seasons the monthly average temperatures were higher than the minimum temperature for the growth of the pathogens on potato dextrose agar, and the relative turgidity of the bark of the hosts was appreciably less than the threshold value of 80 per cent. Cankers continued to develop throughout this period. During the growing season while temperatures were still more favourable for the development of the fungi, no extension of cankers occurred, apparently because, during the growing period, the relative turgidity was in excess of 80 per cent.

Dormant cuttings inoculated with the pathogens and placed outdoors during the winter with their basal ends in water maintained relative turgidity values above 80 per cent, and there was no development of canker. In these instances the hosts did not have to be actively growing to prevent fungus from invading the living bark.

These studies have shown that subsequent to artificial inoculation or natural infection the disease may develop or be suppressed depending on the condition of the living host bark as indicated by its relative turgidity. In many instances the inoculation tests for the determination of the susceptibility or resistance of trees to canker diseases caused by facultative parasites have been undertaken when the host trees are in active growth. These experiments showed that these pathogens do not invade the bark tissues of the hosts during the growing season when the relative

turgidity of the bark is normally above 80 per cent. Therefore, the results of inoculation tests made during the summer may not provide an accurate expression of the susceptibility or resistance of a host to this type of pathogen. Uniformity in the condition of the bark of the host material to be tested, as indicated by its relative turgidity, may be of importance if an accurate expression of the potential of this type of disease is to be obtained.

In Vancouver, the following procedures have proved satisfactory for altering the relative turgidity of viable cuttings to values within the ranges of susceptibility or resistance:

1. A gradual decrease in the relative turgidity of the bark to values within the range of susceptibility to the canker diseases.
   Ends of dormant cuttings sealed with lacquer or paraffin to prevent rapid drying, and placed outdoors in a wire basket protected from a continuous supply of water.
2. The maintenance of the relative turgidity of willow and black cotton-wood bark to values within the range of host resistance.
   Dormant cuttings harvested when the relative turgidity was above 80 per cent and placed outdoors during the winter with their basal ends provided with a continuous supply of water.

The moderate climate during the winters permitted the outdoor storage of cuttings without subjection to prolonged periods of freezing temperatures. Under more severe temperature conditions it would seem possible that the methods outlined could be applied to cuttings stored in a cold-temperature room. A temperature of approximately 5°C. would maintain dormancy in the host material and still be favourable to the growth of the pathogens.

Generalizations from the results of studies correlating the incidence and intensity of canker diseases caused by facultative parasites with seasonal, cultural, climatic, or soil factors are difficult, since many of the interrelated factors vary considerably on a local as well as on a regional basis. Further, a consideration of such results frequently leads to a number of multiple correlations whose relative significance is most difficult to assess. The expression of disease vulnerability on a basis of the moisture content of the bark tissues of the host may be of general application, since at one time and place the water content of the bark would serve as a direct expression of the interaction of the many seasonal, climatic, and soil factors which influence tree growth and vigour. For example, during the winters Fusarium canker occurred commonly on black cottonwood in a nursery, but not on field trees of this species at the University. Bark moisture determinations revealed immediately that the nursery trees had a relative turgidity value below 80 per cent indicating susceptibility, whereas the University trees had a relative turgidity value of 80 per cent or higher, indicating resistance to the disease. Therefore, it may be possible to express vulnerability to such a disease by comparing the relative turgidity values of the bark of trees which occur under varying climatic and soil conditions. Further, a comparison of the relative turgidity values of the bark of different species of poplar in one location may prove of value in explaining varietal resistance or susceptibility to a disease such as Fusarium canker. Variation in relative turgidity between species may be expected and explained on the grounds of differences in bark anatomy and physiology.

On drying, the relative turgidity of the bark of field-grown willow could be reduced to 50 per cent without the cuttings losing their vitality. In nursery-grown black cottonwood, poor survival was obtained from cuttings that were harvested when the relative turgidity of the bark was below 80 per cent. Lowered vitality as evidenced by shoot growth without adequate root growth was considered to be the primary cause for mortality. During the dormant seasons the relative turgidity of the bark of the nursery trees was below 80 per cent for periods during the latter half of November, December, January, and early in February. Therefore, the time of harvesting may be of importance to the percentage survival of the cutting stock. Under the conditions prevailing at the Vancouver nursery it may not be advisable to harvest black cottonwood cuttings when the relative turgidity of the bark is less than 80 per cent. Relative turgidity readings taken immediately before harvesting and planting may provide valuable guides in respect to the ultimate survival and disease vulnerability of the cutting stock.—J. E. Bier.

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The Queen's Printer and Controller of Stationery, Ottawa, 1959

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